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ABSTRACT

This publication examines influences on the present and future physical activity levels of adolescents, noting that the adolescents' physical activity habits, as well as other risk factors, are likely to track into the adult years. Section 1 discusses physical activity in adolescence, noting that adolescence is a time when physical activity tends to decline. Section 2 focuses on the decline of biological drive and the rise in psychosocial influences during adolescence. Section 3 discusses the effects of gender and body composition on physical activity level during adolescence, noting that the decline in physical activity level during adolescence tends to be more exaggerated in girls. Section 4 looks at the limited access to sports play in adolescence. Section 5 discusses adolescent physical activity and other health risk factors. Section 6 focuses on the tracking of physical activity level from adolescence into the adult years. Section 7 presents strategies for promoting physical activities in adolescents, including facilitating the enjoyment of physical activity, creating separate strategies for different age groups, and taking into account various cultural and socioeconomic factors. (SM)

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Adolescence: A 'Risk Factor' for Physical Inactivity

Exercise is good for your health—a lesson learned from the ancients—but the recommendations for achieving such benefits has undergone a significant transition in the closing decades of the Twentieth Century. Most particularly, there has been a shift away from the importance of developing cardiovascular (aerobic) physical fitness and toward the promotion of life-long physical activity. This change has resulted from an understanding that the biological mechanisms linking exercise to health are not simply related to achieving high cardiovascular function but also in increasing caloric expenditure (obesity), weight-bearing activities (osteoporosis), and muscle strength (back problems, physical incapacity in the elderly).

In addition, it has been recognized that most diseases affected by exercise (such as coronary heart disease, hypertension, obesity, and osteoporosis) are a result of life-long processes, surfacing clinically in the older adult years. This observation has prompted an emphasis on promoting exercise habits in children and adolescents as the starting point of a life-style of regular exercise that will be maintained through to adulthood. That is, the introduction of exercise early in life with the key issue of persistence of activity has replaced an emphasis on improving physical fitness to threshold levels (Corbin et al., 1994).

This shift in the exercise-promotion paradigm necessitates a parallel change in focus toward behavior modification rather than exercise training. But in developing this strategy many questions have arisen. How can young people best be "turned on" to being physically active? Can it be truly expected that improving activity habits of an eight-year old girl will cause her to be a more active adult? Given programmatic and financial constraints, should the promotional focus be on certain populations of children who are at particular risk for a sedentary lifestyle (the obese, the athletic "failures")? Or should physical activity promotion be expanded to the pediatric population at large?

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One particularly critical aspect of activity promotion for lifetime health surrounds its timing. It might be assumed that there are certain periods of development when efforts to introduce physical activity habits are more likely to 1) be successful, 2) create an optimal salutary effect on health risk, and 3) be sustained into adulthood. In fact, when guidelines for physical activity for children have been created, special attention has been focused on age-specific recommendations (Corbin & Pangrazi, 1998). There has been a growing recognition that the adolescent years may, in fact, serve as such a pivotal, critical period for activity promotion (Sallis & Patrick, 1994; U.S. Department of Health and Human Services, 1996) and particular guidelines have been suggested for this age group (Table 1). Epidemiologic evidence suggests that levels of activity demonstrate a particular decline during the teen years, especially in females. Adolescence is a key period for changes in certain health risk factors such as the appearance of the initial lesions of coronary artery disease and peak development of bone mineral density. Standing at the immediate threshold of adulthood, the adolescent's physical activity habits—as well as health risk factors—are more likely to track into the older years. Opportunities for participation in organized sports decrease in the teen years, while factors discouraging physical activity, such as access to automobiles,

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become more available. Increases in body fat in the female at puberty may serve to discourage participation in physical activities. The biological drive for physical activity wanes during adolescence at the same time that increasing independence allows teenagers to manage their own lifestyles. They are thus less influenced by parents and more by their peers, and motivation for physical activity depends more on social rather than biological or family factors.

Table 1. Physical Activity Guidelines for Adolescents (Sallis & Patrick, 1994)

1. All adolescents should be physically active daily, or nearly every day, as part of play, games, sports, work, transportation, recreation, physical education, or planned exercise, in the context of family, school, and community activities.
2. Adolescents should engage in three or more sessions per week of activities that last 20 minutes or more at a time and that require moderate to vigorous levels of exertion.
3. Special groups deserve particular exercise prescriptions. For example, obese adolescents may benefit from a program of increased regular energy expenditure through physical activity. Blood pressure may be reduced in adolescents with hypertension by vigorous activity, 3-4 times per week.

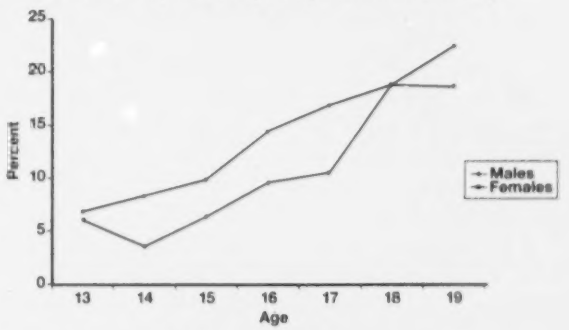
These unique features of adolescence provide both risk and opportunities for exercise-health promotion. The following sections will examine these influences which affect the present and future physical activity of adolescents. Recognizing and understanding these factors may prove essential in developing strategies for exercise promotion at this critical period in life.

Physical Activity in Adolescence

Efforts to improve exercise habits in the population confront the clearly-established trend for a progressive decline in individual physical activity throughout the life span. The daily caloric expenditure (relative to body size) of an 18-year old is approximately half that of when he/she was 6 years old. (This is confirmed by life's experience: consider the Brownian motion of a group of kindergarten children at a birthday party compared to the same individuals at their high school graduation reception.) In reviewing research data, Sallis (1993) concluded that during the school-age years, daily physical activity decreases at a rate of about 2.7% per year in males and 7.4% per year in females. Levels of activity steadily decline during the adult years as well. The percentage of adults in the United States who are sedentary generally increases 2-3 fold between the ages of 20 and 65 years (Stephens, 1987).

It appears that this basic trend for declining activity during life has a biological basis (Rowland, 1998). Evidence supports the presence of an inherent control center within the central nervous system which governs levels of activity. With increasing age, centrally-dictated caloric expenditure through activity declines, paralleling that of basal metabolic rate. The decline in physical activity with age is therefore largely *intrinsic*, the result of a fall in central drive as well as other biological factors, such as a decreasing skeletal muscle mass in older years. There is no question, however, that the shape of the physical activity-age curve, i.e., the *rate* of decline in activity, is influenced by *extrinsic*, or modifiable, factors. And this is where interventional strategies can be effective in improving habits of physical activity. Critical to this approach is the identification and manipulation of psychosocial and environmental determinants which affect the individual's motivation and participation in physical activity.

Figure 1. Percentage of Teenagers Reporting No Participation in Vigorous or Moderate Physical Activity During the Previous Seven Days



Data from U.S. Department of Health and Human Services (1996). Physical activity and health; A report of the Surgeon General.

Evidence exists to suggest that the rate of decline of physical activity is particularly accentuated during the teenage years (Pate et al, 1984). The Youth Risk Behavior Survey indicated that 81% of boys in grade 9 participated in vigorous activity during 3 or more days in the week before the survey (Heath et al., 1994). This proportion decreased steadily during the high school years to only 67% in grade 12. Between the ninth and twelfth grades the percentage involved in such vigorous activity in girls fell from 61% to 41%.

The survey also revealed a downward trend in enrollment in physical education during the course of high school. In the ninth grade, 81% of females and 81% of males were participating in physical education. By their senior year, however, these numbers had fallen to 39% and 45%, respectively.

Riddoch et al. (1991) reported that 11-13 year old Irish boys participated in an average of 33 minutes of activity daily while those 14-16 years were active only 7 minutes a day. In females, mean values were 20 and 12 minutes, respectively. In the Muscatine Study, Janz and Mahoney (1997) used accelerometers to examine the relationship of sexual maturation and daily activity levels during adolescence. Average daily movement, expressed as counts per minute, was 30% less in the postpubertal compared to midpubertal boys. In girls, counts were 19% less at postpuberty compared to midpuberty.

The longitudinal study of Verschuur and Kemper (1985) involved 233 Dutch male and female teenagers using heart rate monitoring to assess activity. At age 12-13 years the boys and girls spent 1.3 and 1.2 hours per day, respectively, exercising at an intensity equivalent to 50% VO_2max. By age 17-18, time had decreased to 0.5 and 0.8 hours per day, respectively.

It is not difficult to suggest explanations for this inordinate decline in physical activity during adolescence. A combination of intrinsic and extrinsic factors are juxtaposed during the teen years which make the adolescent particularly vulnerable to developing a sedentary life style.

The Decline of Biological Drive and Rise in Psychosocial Influences

During early childhood, daily energy expenditure through physical activity appears to be largely biologically-driven. That is, the three year-old who zips about the house does not make a conscious decision to exercise or not. At this age, motivation for physical activity, access to exercise facilities, and support of family members are generally not critical to level of habitual physical activity. As the child grows, the biological drive for exercise energy expenditure declines and extrinsic factors affecting activity levels become more influential. This reaches a particularly critical point at adolescence, when the diminished inherent drive for activity coincides with increasingly important psycho-social factors which influence involvement in physical activity. Unfortunately, these extrinsic factors often act negatively to diminish activity levels during the teen years.

The motivation for physical activity for the typical adolescent, no longer a biological issue, is shaped by factors that involve peer acceptance, physical capabilities, sexual attractiveness, and self-concept. For the talented high school athlete, sports play satisfies these issues. But for the nonathletic teenager, physical activity may be the antithesis of these goals, which are met by "hanging out", rebelling from adult forms, and adopting strange dress or hair styles. For many teenagers, vigorous physical activity is simply not "cool."

These social barriers to regular physical activity are compounded by the growing need for independence with rejection of adult-oriented health goals. The adolescent becomes old enough to drive, has more money and access to fast foods, and increases exposure to cigarette smoking and drugs. All these factors combine to make regular physical activity and other healthy lifestyles unattractive options for many adolescents.

Gender and Body Composition

Epidemiologic studies consistently indicate that males are involved in more total and vigorous daily physical activity compared to females, and this is true during adolescence as well (U.S. Department of Health and Human Services, 1996). In addition, as noted above, some reports suggest that the decline in habitual physical activity during the teen years is more exaggerated in girls. These data imply that adolescence may be a particularly high risk period for developing sedentary habits in females.

Females face social pressures that have historically linked physical prowess and athleticism to maleness, and gender differences in activity have traditionally been accounted for by perceptions that femininity is not consistent with vigorous activity and sports play. While significant progress in dispelling this concept has occurred, detrimental ideas concerning gender-appropriateness in sports play and physical activity persist. Social issues continue to act as important impediments to involvement in exercise by girls. In adolescence these influences are compounded by the burgeoning sexuality at puberty and strong desire for attractiveness to the opposite sex. In males, sexual desirability is often linked to physical capabilities in sports participation and physical activity. In females, on the other

and there are wide variations between cognitive tasks with respect to the magnitude of changes observed with advancing age. Age-related changes in cognitive performance appear to be maximized for tasks which require rapid and complex processing, and are minimized for tasks which are more automatic or which can be performed at a self-paced rate (Chodzko-Zajko & Moore, 1994).

Despite the presence of a cross-sectional association between fitness and cognitive performance, no clear picture has emerged with respect to the effect of exercise on cognitive performance. Several well controlled studies have successfully demonstrated improvement in cognitive performance following training (Dustman et al., 1984; Hawkins, Kramer & Capaldi; 1992; Moul, Goldman & Warren, 1995). However, at least as many studies have not been able to replicate these findings (Blumenthal et al., 1989; 1991; Panton et al., 1990). There is some reason to believe that the magnitude of the improvement in aerobic capacity, as well as the demand-level of the cognitive task may be important factors in determining the presence or absence of training effects. However, it is important to point out that when changes in cognitive performance have been observed following exercise training, the magnitude of these changes has always been small.

Social Implications of Regular Physical Activity:

The vast majority of research studies examining the effects of exercise on the aging process have focused on the physiological and psychological benefits of activity. However, it would be inappropriate to conclude this section without a brief comment about the importance of physical activity for the social functioning of older people. In recent World Health Organization Guidelines for Promoting Physical Activity in Older Persons (WHO, 1997) a number of significant short and long-term effects of physical activity on socio-cultural variables are discussed (see Table 3).

Who should be Physically Active?

Until fairly recently physical activity programming for older adults has tended to focus on a relatively small and healthy subgroup of the older adult population (Chodzko-Zajko, 1995). However, it is now clear that beneficial effects of regular physical activity can be observed in almost all older persons regardless of their physical health. Several excellent and well publicized studies have focused our attention on the benefits of regular physical activity in those cohorts of seniors who were previously thought to be "too old" or "too frail" to partake in structured exercise programming (Fiatarone & Evans, 1990).

Physical Activity Programs for Older Adults:

It is not possible to formulate generic exercise prescriptions which can be applied across the board for all older adults. Individual differences in health status, physical fitness and previous exercise experience require that exercise prescription be tailored to meet the specific needs of each person. Older adults should be encouraged to seek advice from a health or exercise professional, who can assist them in the preparation of an optimal program designed to meet their individual needs. It is recommended that previously sedentary individuals over the age of 40 years should obtain a thorough medical examination before embarking on an exercise program (ACSM 1995). In cases where a physician's examination is not possible, pre-exercise screening questionnaires have been developed which can assist

Table 2

A SUMMARY OF THE PSYCHOLOGICAL BENEFITS OF PHYSICAL ACTIVITY FOR OLDER PERSONS

World Health Organization, 1997

Immediate Benefits:

- Relaxation: Appropriate physical activity enhances relaxation.
- Reduces Stress and Anxiety: There is evidence that regular physical activity can reduce stress and anxiety.
- Enhanced Mood State: Numerous people report elevations in mood state following appropriate physical activity.

Long Term effects:

- General Well Being: Improvements in almost all aspects of psychological functioning have been observed following periods of extended physical activity.
- Improved Mental Health: Regular exercise can make an important contribution in the treatment of several mental illnesses, including depression and anxiety neuroses.
- Cognitive Improvements: Regular physical activity may help postpone age related declines in Central Nervous System processing speed and improve reaction time.
- Motor Control and Performance: Regular activity helps prevent and/or postpone the age associated declines in both fine and gross motor performance.
- Skill Acquisition: New skills can be learned and existing skills refined by all individuals regardless of age.

The WHO Guidelines have been placed in the public domain and can be freely copied and distributed, (WHO, 1997)

Glenmark et al. (1994) described correlation coefficients of r=0.64 and 0.48 for women and men, respectively, between physical activity (by questionnaire) at age 16 and 27 years of age. In a similar study, Barnekow-Bergkvist et al. (1998) found that leisure time activity at age 16 years in males decreased the risk of being sedentary at age 34 years by one-half.

In reviewing both retrospective and longitudinal tracking studies, Telama et al. (1997) concluded that these reports "indicate that physical activity and sport participation in childhood and adolescence represent a significant prediction for physical activity in adulthood. However, the relationship is very low, and, in some cases insignificant." In their own study of young Finns, they found stronger correlations between physical activity in adolescence and 12 years later in adulthood (r=0.21 to 0.26) than from age 9 to age 21 (r=-.01 to 0.15). The effectiveness of *increasing* activity behavior in adolescence as an antecedent to improving adult activity has not yet been examined.

Tracking of physical inactivity may be more impressive. Raitakari et al. (1994) reported that the probability of an inactive 12 year old remaining sedentary at age 18 years was 51-63% for girls and 54-61% for boys.

Strategies for Promoting Activity in Adolescents

Given that physical activity needs to be promoted as a lifelong continuum, it is apparent that different age groups require separate strategies for promoting regular habits of activity. In all groups, however, creating an enjoyment of physical activity in which individuals can be successful and receive peer and family support is key.

Strategies for health promotion are best formulated around recognized age-specific determinants of such activity. Research among adolescents has indicated a number of factors that have been associated with involvement in physical activity in this age group (Table 2). In general these center around opportunities for play, support of friends, and competence in physical activities. It is apparent, too, that the varying influences of cultural group, socioeconomic status, race, geography, and season must be considered when formulating interventional programs (Bungum & Vincent, 1997; Garcia et al., 1995).

Table 2. Psychosocial Factors Associated With Physical Activity in Adolescents.

1. Bungum & Vincent (1997)
   - Ethnicity (Caucasian)
   - Nurture from biological fathers
   - Participation in organized sports
   - Friend support
   - Attitudes toward physical activity
2. Janz & Mahoney (1997)
   - Sexual maturation
   - Less video game playing
3. Gentle et al. (1994)
   - Satisfaction with amount of activity
   - Encouragement from others
   - Desire for competitiveness
4. Garcia et al. (1995)
   - Social support
   - Access to exercise facilities
5. Douthitt (1994)
   - Feelings of self-competence

It is possible that the factors which threaten to diminish physical activity habits during adolescence can be utilized instead as means of exercise promotion. For example, the educational message that the individual can and should accept responsibility for his or her own health (and exercise habits) is consistent with the adolescent's growing need for independence. Similarly, providing the adolescent with a choice of activities may prove more effective than physical education programs that dictate a curriculum. For instance, using community programs, it might be possible to offer a choice of activities such as rock climbing, in-line skating, or kayaking that would prove more appealing to the adolescent than traditional physical education programs.

Taking a cue from anti-smoking programs, efforts could be made to make physical activities more attractive to teens as opposed to an unpleasant life of sloth (i.e., "it's cool to sweat"). Such efforts seem particularly pertinent to females, and the message that vigorous activity is important for girls needs to be continued to be emphasized. This can be supported through the promotional efforts of female athlete role models.

If intramural sports cannot be made available within the school program, such activities should be developed by community recreation departments. The availability of school gymnasiums, exercise rooms, and pools in evening hours could be geared specifically to adolescent groups.

The input of adolescents in creating such programs may be critical to their success. As the "consumers" of preventive efforts, cues as to what "works" may best come from the teenagers themselves. Providing them independence in formulating physical activity programs may also provide a means of increasing participation.

Conclusion

A unique combination of biological and psychosocial factors coincide during adolescence to create a particular importance for health-related physical activity. At the same time, many of these factors provide barriers to stimulating teenagers to adopt regular exercise habits. Innovative physical education programs and exercise promotional efforts specifically directed to this age group are important in overall preventive medicine strategies. Success in these programs may hinge on the ability to utilize characteristics of this age group—need for independence, peer acceptance, desire for choice and variety—in formulating exercise initiatives.

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The President's Council on Physical Fitness and Sports

The President's Council on Physical Fitness and Sports (PCPFS) was established in 1956 through an Executive Order by President Dwight D. Eisenhower as part of a national campaign to help shape up America's younger generation. Today, the PCPFS serves as an advisory council to the President and Secretary of the Department of Health & Human Services on matters involving physical activity, fitness and sports to enhance and improve the health of Americans of all ages.

The PCPFS enlists the active support and assistance of individual citizens, civic groups, private enterprise, and voluntary organizations to promote and improve the physical activity and fitness of all Americans and to inform the public of the important link which exists between regular activity and good health.

Twenty (20) individuals from the sports, fitness and health fields are appointed by the President to serve as members of the Council. They are:

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Physical Activity and Fitness Quote

"A unique combination of biological and psychosocial factors coincide during adolescence to create a particular importance for health-related physical activity. At the same time, many of these factors provide barriers to stimulating teenagers to adopt regular exercise habits."

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